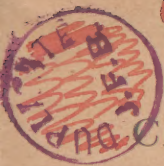


MURPHY (J. B.)
Compliments of Author



Cholecysto-Intestinal, Gastro-Intes-
tinal, Entero-Intestinal
Anastomosis

AND

APPROXIMATION WITHOUT SUTURES

(ORIGINAL RESEARCH)

BY

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ETC.



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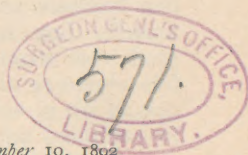
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CHOLECYSTO-INTESTINAL, GASTRO-INTESTINAL, ENTERO-INTESTINAL ANASTOMOSIS, AND APPROXIMATION WITHOUT SUTURES. (ORIGINAL RESEARCH.)*

MR. PRESIDENT AND GENTLEMEN : Intestinal surgery occupies a very advanced place in the category of great surgical questions of the present day. Medical literature teems with reports of successful cases operated on, and not a few of the disasters are also placed on record. All over the world investigators are trying to solve the many perplexing problems that accident and disease of the gastro intestinal tract present to them for consideration. That this subject has had such exhaustive consideration during the last decade, and that it is still a theme for spirited controversy and discussion, carries with it the implication that many vital points are yet unsettled and need further investigation, experimental and clinical. The results of experiments on lower animals have been conducive to great improvement, both in principle and technique of treatment of intestinal lesions in the human subject. Fair results are obtained in the treatment of bullet wounds of the intestines at present. At least an effort is made by the surgeon to repair the injury.

The questions above all others on which the profession is divided are, "What are the best means and methods of producing agglutination of surfaces and preventing subsequent contraction at the point of adhesion?" If means can be devised—I, to hold the surfaces in con-

* Read before the Mississippi Valley Medical Association, October 15, 1892.

tact ; 2, while in contact, to produce a speedy and permanent adhesion of the surfaces ; 3, to keep an opening sufficiently large for the free passage of intestinal contents ; 4, to produce, as a result, a cicatrix that will not contract to any great extent, and by the contraction produce complete or partial obstruction—we will have overcome the great barriers that still remain between us and ideal success in intestinal surgery.

The marvellous ingenuity displayed in plans devised for intestinal approximation and anastomosis is worthy of the greatest success, and that success would have been realized were it not that some of the following complications occurred : “ The suture was imperfectly applied ; the bowel sloughed through at line of suture ; the induced invagination increased after the operation until complete obstruction was produced ; openings in the bone-plates and disks were not in apposition ; the ends of the bone-plates caused pressure, atrophy, and perforation ; the catgut sutures were too rapidly absorbed ; lastly, and with appalling frequency, prolonged operation produced fatal shock,” and many other well-known obstacles, not necessary to mention here, intervened

To overcome these obstacles and thus lessen the risk to the life of the patient, I have devised a mechanical means to dispense with the need of sutures, the necessity of invagination, the possibility of non-apposition, the danger of sloughing through of disks, the too rapid digestion of the catgut, the almost insurmountable difficulties of technique of operation, the prolonged and fatal exposure of the abdominal contents, and the protracted anæsthesia. How much I have accomplished by my labor I desire you to be the judges, after I have demonstrated to you the results of my experiments, and performed for you a gastro-enterostomy and an end-to-end approximation of intestine by means of the device I here present to you, to be known as the Anastomosis Button.

The buttons are made in three sizes. A button consists of two small circular bowls (Fig. 1) ; size No. 2

measures as follows: Diameter, 23 mm. ; depth, 8 mm. There is "sweated" into a circular opening, 12 mm. in diameter, at the bottom of one bowl, a cylinder 15 mm. in length, with female screw thread on its entire inner surface. The cylinder extends perpendicularly from bottom of bowl. There is an opening in the male bowl in which is "sweated" a similar and smaller cylinder of a size to

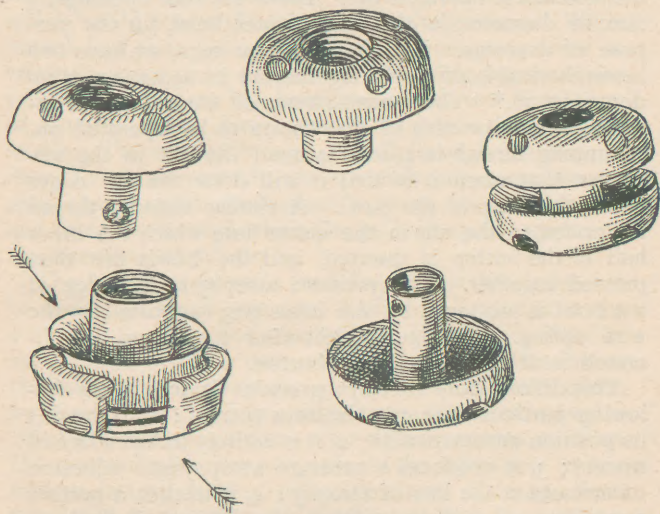


FIG. 1.—Appearance of Button with and without Spring-cup Attachment.

easily slip into the female cylinder. There are two brass springs soldered on either side of the inner surface of the lower end of the male cylinder, which extend almost to the top, where small points of them protrude through openings in the cylinder; these points are designed to catch the screw-thread, when the male cylinder is pressed into the female cylinder, and thus hold the bowls together at any point desired. To separate them again they are simply unscrewed. A small brass ring, with a thin

though not cutting edge, to which is attached a wire spring, is placed in the male bowl and retained in position, projecting 7 mm. above the edge of the bowl. This is held up by the wire spring, and is there for the purpose of keeping up continuous pressure until the entire tissue between the edges of the bowls is cut off. This spring attachment is absolutely necessary only when the stomach is operated on. There are four openings, 5 mm. in diameter, in the side of each bowl, for the purpose of drainage. By this, it will be seen, we have two hemispherical bodies held together by invaginating cylinders (Fig. 1).^{*} These hemispheres of the button are inserted in slits or ends of the viscera to be operated on. A running thread is placed around the slit in the viscus, so that when it is tied it will draw the cut edges within the clasp of the bowl. A similar running thread is applied to the slit in the viscus into which the other half of the button is inserted, and the bowls are then pressed together. The pressure atrophy at the edge of the bowl is produced by the brass ring supported by the wire spring. The opening left after the button has liberated itself is the size of the button.

This differs from all other previous devices in the following particulars or combinations thereof: 1, It retains its position automatically; 2, it is entirely independent of sutures; 3, it produces a pressure atrophy and adhesion of surfaces at the line of atrophy; 4, it insures a perfect apposition of surfaces without the danger of displacement; 5, it is applicable to the lateral as well as to the end-to-end approximation; 6, it produces a linear cicatrix and thus insures a minimum of contraction; and 7, in the extreme simplicity of its technique, which makes it a specially safe instrument in the hands of the everyday practitioner as well as the more dexterous specialist. We will now consider its application.

^{*} Buttons can be procured from surgical instrument makers, or from J. J. Ryan & Co., manufacturer, 80 W. Monroe Street, Chicago.

Cholecysto-Enterostomy. *Gall-bladder and Intestinal Fistula—Gall-bladder and Intestinal Anastomosis.*—The idea of this operation was suggested by nature in establishing pathologically a fistula between the gall-bladder and the intestine. In this way the surgeon was guided to the best means of relief where an occlusion of the duct was produced by the pressure of an impacted concrement, a neoplasm, a cicatricial band, or any pathological lesion which would render the common duct impervious. While nature had thus blazed the way, surgeons were slow to take advantage of its suggestion. The first one to advise this method was my late lamented friend, von Nussbaum, of Munich, 1880. He expressed himself in the following words: "When the escape of gall through the natural duct is no more possible, the question arises can we not make an artificial connection between the gall bladder and intestine through which the gall can again escape into the intestinal tract," etc.¹

The first to work out a feasible plan for the attainment of this ideal result was von Winiwarter.² Between the 20th of July, 1880, and the 14th of November, 1881, he had under his care a man, with occlusion of the ductus choledochus, on which he operated six different times, and finally succeeded in establishing a fistula between the colon and the gall-bladder, after sixteen months of labor. His original plan was to perform the operation in two sittings, but all sorts of difficulties beset his way. It is wonderful what energy and persistence both the operator and patient showed to overcome all impediments. After the publication of his most difficult task it was six years and a half before a surgeon was found who had the courage to undertake a similar operation, when Kappeler³ undertook to follow in the footsteps of Winiwarter, but to do the operation in one sitting.

In the meantime there were several experiments made on animals, with the hope of discovering a means of making a communication between the gall-bladder and the intestine at one sitting. Gaston, in 1883, experimented

on five dogs, with elastic suture, which was so placed as to approximate the gall-bladder and intestine, and around this a row of serous sutures to protect the peritoneum. He hoped by the elastic pressure to produce an atrophy and establish a fistula. The results were unfavorable. In one the sutures sloughed through; two ended in peritonitis; one in abscess between coils of intestine—here the ligature sloughed through into the gall-bladder, and left but an extremely small opening; and in one, at the end of the eleventh day, there was found sufficient adhesion and the fistula was established, the ligature being found in the intestine. In 1884 he used a similar ligature on a young dog, in the same manner, with a good result. In 1886 he made several similar experiments, with the addition of ligating the common duct, but the dogs only lived a few days, dying of extensive gall-infiltration in the liver.

G. Harley¹² suggested the approximation with the formation of fistula from the gall-bladder to the intestine by means of sutures and caustic potash. He arranged a number of sutures in a small circle, about the size of a dollar, holding the gall-bladder to the bowel, but before completing the circle mentioned, cauterized the centre with caustic potash, then completed the circle with sutures, and in that way hoped to produce a fistula of the gall-bladder and have an adhesion by plastic exudation surrounding it. He claims to have had good success in animals.

Colzi, in 1883, put in a circle of sutures similar to Harley's, but before the final suture made an incision in the centre into the gall-bladder and duodenum, also ligating the choledochus. The animals tolerated the operation without any apparent disturbance in the digestive functions.

De Page, in 1887, performed the same experiment as Colzi, on three dogs, without ligating the choledochus. In one the suture sloughed through; another died of peritonitis; the third was killed at the end of six weeks

and showed an atrophy of the gall-bladder, but no fistula. Finally, Dastre,⁴ in his communication to the Physiological Congress at Basel, in 1889, published his experiments, wherein he succeeded in uniting the gall bladder to the intestine for the purpose of studying what effect it would have on digestion. Of this I will speak later.

So that we see to the date above mentioned experiments represented three different types : 1st, The formation of fistula by chemical destruction ; 2d, by pressure atrophy—the elastic ligature ; 3d, careful suturing, with subsequent incision within the circle produced by the sutures.

Up to July, 1890, there were nine “one sitting” operations performed for the establishment of a gall bladder and intestinal fistula in the human subject ; the first by Monastyrski, May 4, 1887.⁵ The incised gall-bladder and jejunum were approximated by two rows of sutures in serous coat. The patient died on August 4th. The fistula was found patulous. Second, Kappeler,⁸ on July 6, 1887, after incision of gall-bladder and duodenum, approximated with a suture of serous and mucous coats, after the method of Woelfler—recovery. Third, Socin,⁶ on November 19, 1887, after incision of gall-bladder and intestine, united them with sutures of mucous and serous coats—recovery. Fourth, Fritzsche,⁷ on April 24, 1888, operated for impaction of gall-stone in choledochus, united incision of gall-bladder and intestine with catgut sutures of mucous coat and silk sutures of serous coat. Patient died on May 4th. Large amount of blood in peritoneal cavity. Fifth, M. Robson,⁸ on March 2, 1889, after incision of gall-bladder and colon, united mucous and serous coats with chromicized catgut sutures—recovery. Sixth, Terrier,⁹ August 13, 1889, after incision of gall-bladder and duodenum, approximated with two rows of sutures, put in drainage-tube, and sutured the gall-bladder to abdominal wound—recovery. Seventh, Courvoisier,¹ March 28, 1890, secured a portion of the gall-bladder, and with serous sutures approximated it to the colon, after having made a ductotomy of choledochus

and removed several stones with curette from the ductus hepaticus—recovery.

The priority of the operation certainly belongs to Monastyrski, for he performed his operation about a month before Kappeler, but did not publish it until eleven months after the operation. Of the seven operations performed, four were for carcinoma of the head of the pancreas, one for carcinoma of the duct at its orifice, and two were for impaction of gall stones—those of Terrier and Courvoisier. The technique in all of the above operations was somewhat similar, the suture being used as the means of approximation, Terrier using a rubber tube to keep the opening patulous, which was passed on the eighth day. The seat of the operation in Terrier's case was the duodenum; in Monastyrski's, the jejunum, 2 m. below the duodenum; in Kappeler's, 226 ctm. above the cæcum; in Fritzsche's case 3 m. below the pylorus.

There remain the cases of Bardenheuer,¹¹ who performed two operations where he united the gall-bladder to the duodenum with an elastic suture in the centre and a single row of silk sutures around it, expecting that the elastic suture would produce a pressure atrophy, and that a fistula would remain. The first case—impacted gall-stone—terminated fatally at the end of four weeks, and the fistula was not yet established, nor had the gall-bladder adhered to the intestine, a biliary fistula opening into peritoneal cavity. The second, he writes to Terrier, was done in the same way, with the same result. To this list, taken from Courvoisier, may be added two by Czerny,¹⁰ of whom one died of hemorrhage and the other survived the operation, and my three, of which I will speak later, making, up to date, in all, fourteen cases of cholecysto-enterostomy of "one sitting." Of these four died as the result of operation—Fritzsche's, two of Bardenheuer, and one of Czerny; five died as a result of the malignant diseases from which they were suffering; and five survived—Terrier's, Courvoisier's, and three of mine.

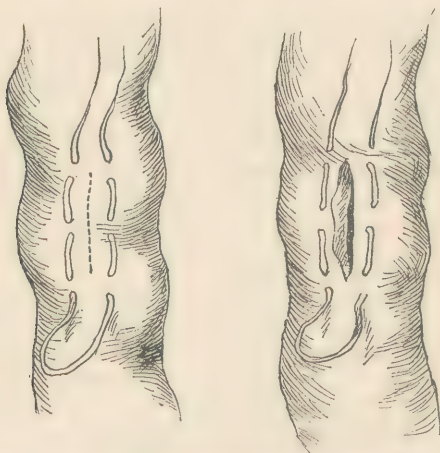
Since writing the above I find a case reported, July 3, 1892, by Dr. E. Lambotte, of Schaerbeek, Belgium,¹³ in which he had an external biliary fistula following cholecystostomy. He drew out a piece of the colon through an incision in the abdomen close to the fistula, and then applied Dupuytren's enterotrite in the manner that that author used it for the repair of an artificial anus, finally performing a plastic operation to close the external opening, in all three operations. The patient survived the very tedious operative procedures. This case does not belong with the class of "one sitting" operations. Also, a case by Korte, reported to the Berlin Medical Society, May 27, 1891, in which the suture was used for approximation. Three operations, recovered.

The various operators, in commenting on the technique of the operation, all agree that it is one of extreme difficulty; and, while the experience of the others was not as trying as that of Winiwarter, it was always most difficult of performance with suture and occupied an hour or upward to complete the operation.

While reading of the great difficulties experienced by the operators mentioned in performing this operation, I realized that the profession was sorely in need of some more simple and perfect means for the approximation of the gall bladder and the intestine; and, after trying several devices, I succeeded in producing and perfecting this anastomosis button, which I think fulfils all of the indications. The button is inserted in the following manner:

An incision is made from the edge of the rib, two inches to the right of, and parallel to, the median line, extending downward three inches. The gall-bladder is drawn into the wound, also the duodenum. The duodenum is cleared of its contents by gentle pressure with finger. My short intestinal compression forceps are placed upon the duodenum to prevent the escape of gas and fluids after the incision is made. A needle with fifteen inches of silk thread is inserted in the duodenum, directly op-

posite its mesentery and at a point near the head of the pancreas. A stitch is taken through the entire wall of bowel, one-third the length of the incision to be made. The needle is again inserted one-third the length of the incision from its outlet, in a line with the first, and brought out again, embracing the same amount of tissue as the first (Fig. 2). A loop three inches long is held here, and the needle is inserted in a similar manner, making two



FIGS. 2 and 3.—Showing Running Thread before and after Incision in Bowel.

stitches, parallel to the first, in the reverse direction, and one-eighth of an inch from it, coming out at a point near the original insertion of the needle (Fig. 2). This forms a running thread, which, when tightened, draws the incised edge of the bowel within the cup of the button. In the gall-bladder a similar running thread is inserted. An incision is now made in the intestine, two-thirds the length of the diameter of the button used. The button is slipped in, as I will show you in my demonstration, the running string tied, and the button held with the forceps.

The contents of the gall bladder are withdrawn with an aspirator. An incision is then made in the gall-bladder the same length, and between the rows of sutures, the button is inserted in a similar manner, and the running string tied. The serous surfaces to be approximated are scraped with the edge of a scalpel. The forceps are removed and the button is held between the fingers and pressed together (Fig. 4). A sufficient degree of pressure must be used to bring the serous surfaces of the gall-bladder and intestine firmly in contact and compress the tissues. The elastic pressure of the spring cup of the button produces a pressure atrophy of the tissue embraced within the cup, and leaves an opening as large as the button, the button dropping into the bowel and being passed through the intestines.

It takes about as long to describe the operation as to perform it. The time occupied with the first lady on whom I operated was eleven minutes, from the entering of the peritoneal cavity until the closing of the same. On dogs I was from eleven to eighteen minutes in performing the operation, the latter time being on the first dog, before I had made the various improvements in the technique and button. The operation is more difficult to perform on the dog than on man, as it is more difficult to bring the gall-bladder into the wound.

To show that this operation is one that the busy surgeon will be frequently called upon to perform, now that the technique is so simple, I have only to remind you of the number of cases of chronic jaundice from obstruction of the common gall duct, requiring some operation for relief, and to draw your attention to the defects of the operations now in vogue, namely, the unpleasant and sometimes dangerous sequence of cholecystostomy, an external biliary fistula, which may of itself be a menace to life, and require a second operation even more critical than the first, as is shown in the following reports by Courvoisier; also the difficulties and dangers of cholecystectomy.



FIG. 4.—Button as Held when 'Pressed Together' Performing Cholecysto-enterostomy.

The effect of a permanent fistula of the gall-bladder and constant escape of bile secreted, as frequently follows cholecystostomy, is different, depending, first, on the quantity of bile that escapes from the opening, and, second, what proportion is admitted into the intestinal tract. This fact has been lost sight of by many of the surgeons that have operated, and had an external fistula remain, which accounts for the great differences of opinion as to gravity of biliary fistula. Where the fistula of the gall-bladder only allows a portion of the bile to escape, the patient and animal, as in Dastre's experiments, can live without suffering from the loss; that is, they are capable of digesting with a much smaller quantity of bile than they naturally excrete. But if we let the entire quantity of bile escape through a fistula, the patient soon succumbs. This is thoroughly demonstrated by the twelve cases collected by Courvoisier.¹ In one of these cases, reported by Krumpmann,¹² the average daily quantity of bile escaping through the fistula was 230 gm.; still the patient lived eight years in this condition. Where such an able authority as Courvoisier classes this with his cases in which there was an escape of the entire quantity of bile, it may appear presumptuous to question the propriety of placing it in that class; but as the quantity is so much below the average given by physiologists, and as the effect on the patient was at such variance with the more reliable cases, I must ask you to analyze it. For example, some estimates of the quantity daily excreted are—by Wittich, 532 c.c.;¹⁴ by Westphalen, 453 to 266 gm.; Ranke, 652 c.c.; Murchison, 40 ounces. When compared with that given by Krumpmann, we are certainly justified in doubting its reliability, and in not placing it with unquestionable cases. All patients died where the entire quantity of bile secreted escaped through the fistula, and where a large quantity escaped the patients became emaciated and sick. Therefore a safe means of allowing the gall to re-enter the intestine should be welcomed by the surgeon

and patient. This operation will produce the same revolution and favorable change in the surgery of the gall-bladder that the intra-abdominal treatment of pedicles did in the treatment of tumors of the uterus and its appendages.

The following experiments were performed on the gall-bladder :

Experiment 4.—June 5, 1892 ; male dog, weight 70 pounds. Abdomen shaved, incision three inches long, in the median line. The duodenum was easily reached—as it passes from the end of the stomach close to the liver—and brought into the wound ; the gall-bladder was also drawn forward and held with the forceps. The incision was made in the gall-bladder and one-half the button inserted ; a running thread was placed around the circumference of the opening, and the thread tied ; the gall-bladder was allowed to recede. An incision was made into the duodenum, parallel to the bowel, opposite its mesentery, large enough to admit the button. A running thread was sewed into the edge of the incision, one-half of the button inserted, and the running thread tied. The button was pressed together. The approximation was perfect ; time, eighteen minutes. The dog had no unpleasant symptoms until the third day, when he appeared sick and refused to drink. On the fifth day he was much improved, and on the sixth he had completely recovered ; he was playful as if nothing had happened to him. On July 10th, thirty-five days after the operation, he was killed. The button had escaped, and the opening was found large enough to admit the little finger from the gall-bladder into the intestine (Fig. 5). There was no food nor hair in the gall-bladder, as a valve was formed on the intestinal side of the opening by two folds of the mucous membrane closing over it, permitting the bile to flow out, but preventing the entrance of anything from the intestine. This valve (Fig. 5) could not have been more perfect had it been prearranged. The gall-bladder was very much contracted. You can examine the result in specimen.

Experiment 5.—June 12, 1892; black male hound, weight 55 pounds. Operation performed the same as in Experiment 4. Some bile escaped into the peritoneal cavity. The attachment of the gall-bladder to the liver was torn slightly in the effort to bring it further forward into the opening. The button worked admirably. Time, sixteen minutes. The dog did not suffer in the least after

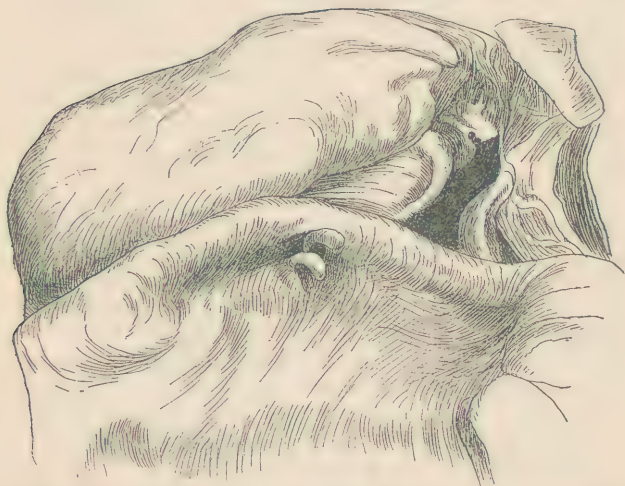


FIG. 5.—Opening with Valve, on Intestinal Side, after Cholecysto-enterostomy.

the operation, being playful and able to eat at all times. August 22d he was killed. A perfect union was found between gall-bladder and duodenum. The gall-bladder had contracted to about the size of the common duct. The opening between intestine and gall-bladder would admit the end of the little finger. A valve similar to that described in Experiment 4 was found. Neither hair nor food was found in the gall-bladder.

Experiment 7.—June 14, 1892; St. Bernard, female,

weight 100 pounds. Cholecysto-gastrostomy, operated in the same manner as in Experiment 4, only using the stomach in place of the intestine. No escape of bile or gastric fluid into the abdominal cavity. A little difficulty experienced in approximating the ends of the button on account of the thickness of the wall of the stomach. Time, seventeen minutes. Dog sick the following day, would not eat or play. On the 17th all symptoms had disappeared. August 9th, killed dog; found gall-bladder firmly united to the stomach; little finger could be inserted into the stomach from the gall-bladder (Fig. 6); there was neither food nor hair in the gall-bladder, which was somewhat contracted. No cholecystitis nor choleangitis. The dog did not seem to suffer any inconvenience from the gall passing into stomach.

Experiment 13.—July 7, 1892; black dog, weight 65 pounds. Cholecysto-enterostomy. The gall-bladder was brought into the opening without lacerating its attachment to the liver, and the running thread inserted; operation completed as above. Some escape of gall into the peritoneal cavity. Time, sixteen minutes. Killed dog, August 23d; found the gall-bladder contracted to a tube not much larger than the ductus cysticus; opening into intestine admitted the little finger. Valve formed by fold of intestinal mucous membrane. Water would flow freely from the side of the gall-bladder into the bowel, but would not flow from the bowel into the gall-bladder on account of this valve. Neither hair nor food in the gall-bladder.

Experiment 18.—August 2, 1892; white female dog, weight 95 pounds. Cholecysto-enterostomy; ligature of common duct; operation otherwise as above. Time, eleven minutes. Result examined August 6th. Found a perfect adhesion of gall-bladder to bowel; button in position. Hair and food in gall-bladder.

Experiment 21.—August 30, 1892; red and white hound, weight 90 pounds. Cholecysto-enterostomy. Time, fourteen minutes. No difficulty experienced; the

dog had no unpleasant symptoms following. Killed on September 14th; found perfect union of gall-bladder to bowel. Partial atrophy of tissue in clasp of button; button in position; hair and food in gall-bladder; gall-



FIG. 6.—Opening in Stomach after Cholecysto-gastrostomy.

bladder about the normal size. This dog was killed thus early to find what changes would take place in fourteen days.

Report of Cases.—CASE I.—A. Q——, aged thirty-five, female; admitted to the medical department of Cook County Hospital, May 27, 1892. Transferred to

the surgical division of the hospital, June 10, 1892, and came under my care. Gave the following history: During the last fifteen years has had stomach troubles; pain and tenderness in the epigastrium; the attack would last from two to four days, was almost always accompanied by vomiting, not by jaundice. Had pain in back since child-birth; suffered from chronic constipation. One of these attacks was accompanied by jaundice for the first time, December 14, 1891. At that time had constant and intense pain for twelve hours, and an aching pain and tenderness in the epigastrium for two months following it. Jaundice cleared in about two months. During the past few months the attack of stomach trouble would last from twelve to twenty-four hours. In February the present attack began, accompanied by jaundice and severe pruritus, which has been constant from that time up to date. These symptoms increased in severity up to the time she was admitted into the hospital. While in the medical department her jaundice was constant; her mental condition became very much impaired and her emaciation rapidly increased.

Condition when Admitted to the Surgical Department.—The patient intensely jaundiced; very much emaciated; has a point of tenderness in the right hypochondriac region just below the margin of the rib; no tumor to be felt. The urine contains a large quantity of bile, no albumin. The patient suffers from considerable mental derangement, very slight elevation of temperature.

June 11th.—I decided to perform cholecysto-enterostomy by means of my anastomosis button, which I had used for the first time on a dog six days previous. An incision three inches long was made, three inches to the right of the median line, extending directly downward. The gall-bladder was found distended, non-adherent, and contained a large number of small calculi. Two calculi were found in ductus choledochus and allowed to remain. Duodenum and gall-bladder were both drawn into the wound; an incision was made in the duodenum and half of

the button inserted. A running thread was put in the gall-bladder, an incision made, and the other half of the button inserted. The gall-stones were not removed. There was considerable escape of gall, as gall bladder was not aspirated before putting in the button. The button was then pressed together without any difficulty, and the mass dropped into the abdominal cavity. Time from the opening of the peritoneum until the closing of same, eleven minutes. After the operation the patient showed no unpleasant symptoms; temperature at no time exceeded 100° F., and in fourteen days from the operation she was allowed to walk about the ward. The jaundice rapidly disappeared, and three weeks after the operation there was no trace of bile in the urine. The patient was of a very hysterical temperament after her mental condition improved; she noticed that she was an object of observation and became so erratic that we could not control her at the hospital and were compelled to discharge her five weeks after the operation. Up to that time she states that "she has not passed the button." She was apparently well in every particular. The button used in this case was very imperfect compared with the present one.

October 28th.—Patient was examined by Dr. H. R. Wittwer. He found the jaundice had not returned; there was no bile in the urine, and the patient was in excellent health. He could not ascertain whether she had passed the button or not.

The following case was referred to me by Dr. Hoelscher, who with Drs. Wiener and Lee assisted me in the operation.

CASE II.—Mrs. B——, aged thirty eight, widow, has three children. Parents still alive, aged seventy-six and seventy-four respectively. Brothers and sisters well; no history of any hereditary disease.

Dr. Hoelscher saw the patient for the first time October 7, 1892, and found her as follows: "Healthy, well nourished appearance; pain of sudden onset in the epigastric

region, and from this point it gradually extended over the whole abdomen. She had vomited the contents of the stomach and some bile on two occasions after the seizure with pain. Bowels were constipated and had been in this condition two or three days before the seizure. Vesical tenesmus and diminished quantity of urine. Gave no history of any previous pain, gastric disturbance, jaundice, or colics."

On examination found a tumor in right hypochondriac region, extending downward into the iliac region and terminating in a rounded smooth end; could be distinctly felt in lumbar region, was movable and tender on pressure; there appeared to be a deep fissure between the tumor and the liver, no fluctuation apparent, bowel or colon not overlying the tumor. The diagnosis could not be determined, but it was presumed to be some lesion of the kidney, so it was decided to make an exploratory laparotomy.

October 19th.—I made an incision three inches long, from the edge of the tenth rib directly downward toward the border of the ilium. The tumor was exposed and found to be a very much enlarged gall-bladder with large calculi within. The viscus was very œdematous, red, and thickened. It was decided to make a cholecysto-enterostomy with my anastomosis button (No. 2). The gall-bladder was aspirated, and the running thread inserted. The running thread was then inserted into the duodenum and the intestine incised and the male half of the button inserted, the female half was then placed in the gall-bladder through a slit made between the running thread, and the button closed. The gall bladder measured at least 1 ctm. in thickness and was very œdematous. There was no difficulty in inserting the button. The gall-stones were allowed to remain, as I do not consider it necessary to remove them unless they are larger than the button. They will pass out after the button escapes.

October 20th.—Temperature, 101° F; pulse, 96. Vomited considerably during the night and complained of headache, which seemed to be effects of the an-

æsthetic. There was no pain nor abdominal tenderness.

October 21st.—At 5 P.M. yesterday the vomiting ceased, and the patient is feeling very well this morning.

October 27th.—The patient has had no unpleasant symptoms since October 20th. This morning (eight days after operation) in the stool were found two large gallstones. The larger one weighed 117 grains (7.8 gm.); its longest diameter 1 inch, its shortest $\frac{7}{8}$ inch. The second stone 102 grains (6.8 gm.); its longest diameter $\frac{7}{8}$ inch, its shortest $\frac{3}{4}$ inch. It will be noticed that the shortest diameter of the larger stone measures exactly the same as the diameter of button used. The patient is feeling very well and is sitting up in bed. Complete primary union. Button passed eighteen days after operation.

CASE III. *Cholecysto-enterostomy with Button No. 1.*—This case was referred to me by Dr. J. H. Hoelscher, who gave me the following history: Mrs. Z——, aged thirty-six, married, six children. Enjoyed perfect health until twenty-two years of age; at that time, three months after childbirth, had an attack, of short duration, of severe epigastric pain and vomiting. It was not accompanied or followed by jaundice. Ever since that attack she has had digestive disturbances, as distress following certain kinds of food, eructations of gas, constipation, loss of appetite. Four years ago she had a similar attack of pain in the epigastrium, accompanied by vomiting. From that time on the pain returned every five or six weeks, up to five months ago, when she noticed a constant aching pain and tenderness in the right hypochondriac region, that persisted until the present time. The pain and soreness were very much increased after working in a stooping posture. She has suffered much from general debility, and complains of slight and frequent chills. Throughout the entire progress of her disease jaundice was never present. The urine was tested several times for her with negative results. She does not give a distinct history of having had "hepatic colic."

About three months ago she found small particles, the size of mustard-seeds, in the fæces, which someone told her were gall-stones. There is no positive evidence that she ever passed a gall-stone. Physical examination revealed a heart and lungs normal ; liver not increased in size. Manipulation reveals a pear-shaped, hard tumor in the region of the gall-bladder, measuring about three inches in length, and two in width. It moves synchronously with the diaphragm in respiration. On pressure considerable pain is produced, and a slight crackling sensation is felt by the fingers.

It can be separated from the kidney, and can be moved considerably from side to side. The diagnosis of gall-stone was made by Dr. Hoelscher, and the case was referred to me for operation.

Operation, November 23, 1892, assisted by Drs. Hoelscher and Lee, in the presence of Dr. Nicholas Senn, who expressed a desire to see my method used, Dr. Dunne, of Minneapolis, and Drs. Mayo, of Rochester, Minn. The incision was made the same as in Case II. ; contracted gall-bladder packed full of gall-stones slipped into the wound.

A little difficulty was experienced in drawing the duodenum forward, as some old adhesions existed. The running threads were inserted in gall-bladder and duodenum ; male half of button placed in duodenum, and held by an assistant. An incision was made in the gall-bladder, which was found so full of gall-stones that half of the button could not be inserted without removing some of them. A dozen were quickly picked out with the dissecting forceps. About twice as many were allowed to remain. The female half of the button was inserted in the gall-bladder and the running thread tied. Button pressed together. Toilet of field of operation was made with dry sponge and the viscera dropped back into abdomen. Deep and superficial row of sutures in abdominal wall. Time for entire operation, twenty-one minutes. The time for inserting the button was not

taken. Patient rallied rapidly from the anæsthetic. Pulse after operation, 70. Temperature normal. Neither nausea nor vomiting.

November 25th.—Pulse, 78. Temperature, 100.5° F. Patient complains of slight pain at seat of operation. No tympanites nor abdominal tenderness.

November 28th.—Patient expresses herself as feeling very well. At no time since the operation has patient's temperature exceeded 100.5° F. She is allowed to take a quantity of liquid nourishment, but not sufficient to satisfy the appetite. I consider her now out of danger. The ease and rapidity with which this operation was performed satisfied those who witnessed it, as well as myself, that the operation of cholecysto-enterostomy by this means is relieved of many of its dangers and all of its difficulties. Dr. Hoelscher is to be congratulated on his diagnosis in this case, in the absence of so many important symptoms.

Gastro-Enterostomy.—The frequency of diseases of the pylorus and its surroundings which produce an occlusion, partial or complete, of that orifice, causes the surgeon to be often called upon for the relief of the unpleasant and dangerous symptoms arising therefrom. As the diseases themselves are frequently of a malignant character, or of such a nature as to be irremovable, we can only hope to relieve the patient of the unpleasant symptom of vomiting, and prevent him from dying of starvation. This operation, by which the intestine and stomach are approximated and an opening for the passage of food is made, is known as gastro enterostomy.

The difficulty of establishing this opening by means of sutures has deterred the majority of surgeons from operating, except in desperate cases where the patient preferred death to a continuance of his miserable condition, and was occasionally accommodated with the former by the operation. The time occupied and the difficulties of the technique were so great that many of the patients on whom the operation was performed succumbed from the

prolonged anæsthesia and long exposure of the abdominal contents; or, surviving these, died from a defect in the sutures or sloughing through at the line of suture. Mortality before bone-plates were used (with suture), 42.8; with bone-plates, 24.5 per cent.¹⁵ If the surgeon had some means by which he could safely and rapidly approximate the stomach and intestine, I am sure he would often be able to respond in the affirmative to his patient's plaintive interrogatory, "Doctor, can you not do something for this vomiting and starvation?" When the doctor has the means of performing this operation, even as an amateur, in the short space of nine minutes, and after a little practice in as low as six minutes, as I have done on the living patient; when the technique is so simple that his patient is free from the effect of the prolonged exposure of the abdominal contents, I am sure he will undertake it with pleasure and confidence; and would have no hesitancy in applying such a simple procedure to rescue his patient from such an extremely unpleasant and dangerous condition. True, in the malignant growth the disease is not cured by gastro-enterostomy, but that most unpleasant of all symptoms, the constant vomiting, is relieved, and the patient is allowed to lead a life of comparative comfort until the end is brought on by general marasmus. The following experiments were made:

Experiment 16.—July 27, 1892. Black hound, same as in Experiment 9; weight 55 pounds. An incision in the linea alba from the xiphoid cartilage extending down three inches. Omentum torn. The under surface of the stomach was exposed and drawn into the wound with the fingers. A loop of jejunum from the neighborhood of the left kidney was also drawn into the wound. The running threads were inserted in the stomach and bowel. The incision was first made in the stomach, and male portion of the button inserted, the running thread tied and cut short. The button was now pressed together, a perfect approximation being produced. The mass

dropped back into the abdominal cavity. Time, fourteen minutes. July 28th, dog appeared in perfect health ; not the least unpleasant symptom ; playful, and ate as usual. August 23d, dog killed ; found perfect union of stomach and intestine. The tissue clasped within the button did not completely slough, and the button was held in position. The reason the tissue did not slough was on account of the thickness of the walls of the stomach. After a certain degree of atrophy had taken place pressure ceased, and there was sufficient tissue retained between the edges of the button to keep up the circulation in tissue within clasp of button. This operation was performed with the button before I had the elastic compression ring attached to it, and the fact that atrophy did not take place was what led to this modification.

Experiment 17.—July 31, 1892. Brown female dog, weight 22 pounds. Gastro-enterostomy. The duodenum was joined to the stomach near the head of the pancreas. No gastric fluid nor gases escaped during the operation. The button was inserted as above ; no omental flap ; two rows of sutures in the abdominal wall. The dog showed no unpleasant symptoms after the operation. Time, fourteen minutes. August 9th, killed dog ; found a perfect union of duodenum and stomach ; button yet in position, as shown in specimen. The dog was killed thus early to ascertain the degree of atrophy at end of ten days.

Experiment 20.—August 23, 1892. Brown female, weight 100 pounds. Gastro-enterostomy. Performed in my laboratory by Dr. Alex C. Wiener. The under surface of the stomach was exposed as above, the duodenum brought forward, the button inserted and compressed. Time, twelve minutes. The dog showed no unpleasant symptoms after the operation, eating and drinking as usual, and very playful. September 7th, fifteen days after the operation, found perfect union of stomach and bowel ; button still in position ; partial atrophy of tissue clasped within it.

Experiment 23.—August 30, 1892. Woolly female, weight 70 pounds. Gastro-enterostomy. Performed in my laboratory by Dr. C. Fenger. Method of operation same as above. Time, nine minutes. A new button was used in this operation, and the degree of pressure greater than in the previous ones. Dog died on the third day. It was found on post-mortem examination that the manufacturer, in his endeavor to make the button light, had made the rim of bowl at one place so thin that it had a cutting edge, and it cut completely through the wall of the stomach and bowel at the time of operation. A similar button was used in another case with the same result.

I performed the operation of gastro-enterostomy three times with the button on the human subject, and Dr. Wiener did it once. In all of the cases we got a primary adhesion. I will give a detailed report of these cases in a subsequent clinical paper on the subject, which I am preparing.

Pylorectomy.—The operation for removal of the pylorus with a portion of the stomach and duodenum. The operation was first performed by Rydyger, but Billroth and Woelfler brought it most prominently before the profession. I will not go further into the history of the operation, with which you are all familiar. In performing this operation I have deviated considerably from the beaten path, and proceeded as follows :

After drawing the pylorus into the abdominal wound, ligating the greater and lesser omenta and cutting them off, I then made a circular incision with the scissors on groove director, cutting through the muscular and serous coats of the stomach down to mucous coat, completely around the stomach where it was to be excised. I then denuded the mucous membrane of its muscular and serous coats for half an inch in the direction of the pylorus. A silk ligature was placed around the mucous coat at the line of the original incision. A large compression forceps was placed on portion of stomach to be

removed. The mucous membrane was cut off half an inch below the ligature. This then presented the appearance of a rosette. A puckering stitch was run all around the edge of the mucous membrane and tied. The silk ligature was then removed. An interrupted silkworm-gut suture approximated the peritoneal and muscular coats of the stomach over the corrugated stump of the mucous membrane, completely closing the end of the stomach. The duodenum was excised an inch and a half below the pylorus, a running thread was placed in position and the button inserted. The other half of the button was inserted in the posterior wall of the stomach, two inches from line of suture, in the usual way, and the button pressed together. It was found before placing the button in the duodenum that the head of the pancreas came within an inch of the pylorus, and that the bowel had to be denuded of a portion of its peritoneum by loosening the end of the pancreas in order to allow the button to be closed. This would not occur in the human subject, as the head of the pancreas is a considerable distance from the pylorus.

The advantage of this operation over the one frequently performed—that of sewing the end of the bowel in the opening made by the excision of the stomach—is, first, that there is no dead point at the angle of suture between the stomach and bowel, which has been the cause of the greatest fatality in this operation; second, the rapid and easy closure of the mucous coat; third, the assurance that there would be sufficient opening for the easy exit of the contents of the stomach during the process of healing, thus preventing tension of the sutures at the end of the stomach; fourth, advantage over the lateral approximation operation by the subsequent mixing of the food with the secretions of the liver and pancreas in about their normal way, and avoiding the danger of the great contraction that follows it; fifth, the great saving of time, the operation in the usual way occupying three and one-half to four hours, while in this method it occupies

about one hour ; sixth, no possibility of escape of stomach contents at time of operation ; seventh, that there is but very little hemorrhage. The following experiments were performed :

Experiment 30.—September 14, 1892. Black and white dog, weight 60 pounds. Pylorotomy. Ligature of greater and lesser omenta ; separated the same from the pylorus. Complete circular incision was made through serous and muscular coats of stomach down to the mucous membrane. The mucous membrane was denuded of its serous and muscular coats for half an inch from incision in direction of pylorus. Silk ligature placed embracing entire mucous layer, incised through mucous membrane at end of denudation, purse-string stitch placed in mucous membrane, and tied. Ligature removed. Interrupted silk sutures approximated muscular and serous coats at same time. Excision of duodenum an inch and a half below pylorus. Running thread placed in bowel, and half of button put in position. It was found that the head of the pancreas had to be torn from the attachment to the bowel in order to admit of the closing of the button. Posterior wall of stomach incised, and other half of button inserted. Button pressed together, and all dropped back into the abdomen. No omental flap. Time was saved in the manner of treating the mucous membrane of the stomach, which had not hitherto been suggested. No escape of contents into abdomen. Time, forty-four minutes. Dog killed on September 27th ; a considerable quantity of sero-purulent fluid in abdomen ; the silk sutures at the end of the stomach had suppurated ; the mucous membrane was firmly united ; the bowel firmly adherent to the stomach ; the button in position. On one side a small sinus, leading half an inch from the edge of the bowel along the wall of the stomach was found, which had not perforated into the abdominal cavity. This sinus occurred where the end of the pancreas had been torn from the bowel, which accounts for the sinus.

Experiment 32.—October 2, 1892. Black dog, weight 90 pounds. Operation performed as in Experiment 30, except that the duodenum was sewed at the end with continuous silkworm-gut suture, and a lateral anastomosis



FIG. 7.—Pylorectomy. Lateral Approximation of Duodenum to Stomach.

made with the button between the duodenum and stomach, three inches from end of duodenum (Fig. 7). Time, sixty-two minutes. Operation made with new spring button. October 10th, the dog has been sick with influenza from the time of the operation until October 9th, when he again began to eat. However, on October 15th, the dog succumbed to the distemper. Autopsy showed a perfect union between stomach and bowel, with a linear

cicatrix. The button had passed; the opening left was as large as the button and looked as though it had been punched out, as seen in this ideal specimen.

End-to-End Approximation of Intestine.—The many diseased conditions of the intestinal tract leading to obstruction, the many accidents resulting in strangulation and local death, the many injuries to the intestinal canal causing solution of continuity, have led to extensive study and numerous operative procedures for the purpose of restoring the bowel to its normal condition, and re-establishing the circulation of its contents. Many have been the methods that have been suggested, and still more numerous have been the modifications. This has been especially true in the last decade, and still we had not attained an ideal means of securing a perfect union. For centuries efforts had been made to unite the bowel in its most natural position, that is, end to end. More recently the tendency in experiments has been to unite it laterally. The various means hitherto used to produce apposition I will divide into two classes: first, the suture; and, second, the insertion in the bowel of a foreign body as an assistance to the suture. Of the suture I will not speak, except to call your attention to the one recently devised by Dr. M. E. Connell,¹⁶ of Milwaukee, which is certainly worth a trial. Foreign bodies in the shape of cylinders, both soluble and insoluble, such as the tracheæ of animals, tallow candles, sections of dried intestine, sections of elderwood, metallic rings, gelatine and rubber tubes, and very many other materials have been used. These have been tried from time to time, always in connection with the suture. Some of them have rendered good service, and still hold a respectable place as an aid to the suture in circular enterorrhaphy, as Pall's decalcified bone-tubes, Byron Robinson's rubber-tube, with which he obtained good results, and still later, Jessett's ingenious device. The advantages and disadvantages of these various devices you already understand. The device which I have shown to you to-day differs from all

that have been used before in the following particulars or combinations of them ; first, in that it retains its position automatically when closed ; second, that it produces its union independently of suture ; third, that there is a perfect approximation of serous surfaces, and that that approximation must remain until a pressure atrophy takes place where the ends of the bowel are pressed together. There are precautions to be taken in putting in the running thread in the end of the bowel. If you carefully follow the lines indicated by the suture (Fig. 8), you will, 1st, prevent the eversion of the mucous membrane ; and, 2d, you will produce an overlapping of both layers of the serous coat of the mesentery at point *a*, Fig. 8.

This overlapping is produced, as you will notice in the figure, by making one top stitch at that point (*a*). This approximation of the two peritoneal layers of the mesentery is of vital im-



FIG. 8.—Manner of Inserting Running Thread in End of Bowel.

importance, as otherwise you would have the muscular layers of the bowel coming in contact between the edges of the button and get no adhesion. If the running

thread is properly applied as in Fig. 8, when tied it will have the appearance of Fig. 9, and have a continuous surface of peritoneum around the entire edge of the button.

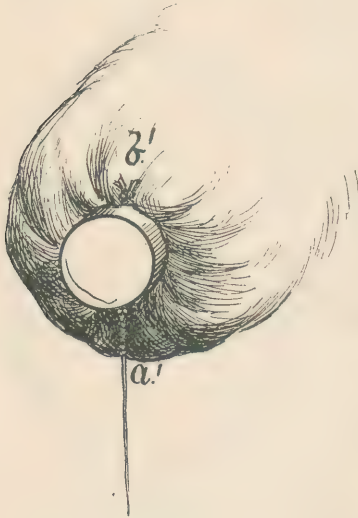


FIG. 9.—Appearance after Drawing Running Thread around Cylinder of Button.

When inserting the half of the button to which the circular ring is attached, compress the ring to a level with the bowl, grasp the edge of the bowl with the forceps and hold it compressed while you make the first half of the knot, and draw the end of the bowel close about the central cylinder; then change the forceps to the edge of the cylinder, and complete the knot. When the button was first devised it was not intended to use it for

this purpose, but I find it very well adapted to intestinal approximation, as shown by the following experiments:

Experiment 12.—July 7, 1892. Brown female dog, a St. Bernard, weight 80 pounds; the same as used in Experiment 7. End-to-end approximation of ileum by means of button. The bowel was freed of its contents by gentle pressure with the fingers; it was incised; a running thread was inserted around the proximal end of the bowel, close to its edge, and the half of the button inserted (Fig. 11); the distal end was treated in like manner and the other portion of the button placed in position and the button pressed together (Fig. 12). Omental flap was placed around the point of union, and held in

place by the silkworm-gut sutures. Time of operation, twelve minutes. The dog showed no unpleasant symptoms after the operation. July 27th, examined the result of this operation; while making cæcectomy on the same dog, found a perfect union between the ends of the bowel; omentum adherent all around; no adhesions between the united intestine and abdominal wall. There was no contraction of bowel at the seat of union, and it was very difficult to make out the line of approximation on the serous surface. The button had already passed.

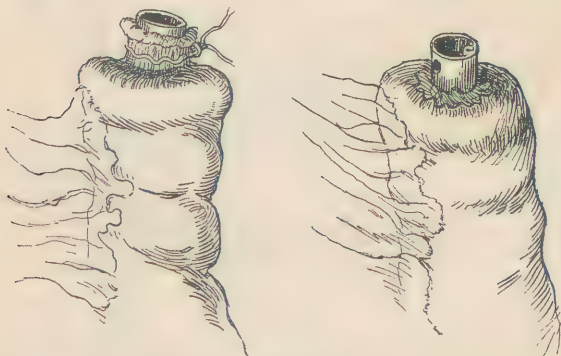


FIG. 10.—Appearance of Ends of Bowel with Portions of Button Inserted Ready to Close.

August 9th, killed dog; found the bowel as described above. There were three operations on this dog—cholecysto-enterostomy, end-to-end approximation of the ileum, and cæcectomy, with end of small intestine approximated to end of large intestine.

Experiment 11.—July 5, 1892. Black and white dog, weight 60 pounds. End to-end approximation. Omental flap. Continuous silkworm-gut suture was used in abdomen. The dog was not sick after the operation. On July 10th, five days after the operation, the dog, in licking the wound, loosened the suture and allowed the bowel to es-

cape. He was then killed. The ends of the bowel were perfectly adherent; a plastic exudate obliterated the line of union on the peritoneal side of the bowel. The button was found in position (Fig. 13).

Experiment 14.—July 11, 1892. Spotted dog, same as in Experiment 3 (in another paper I am preparing); weight

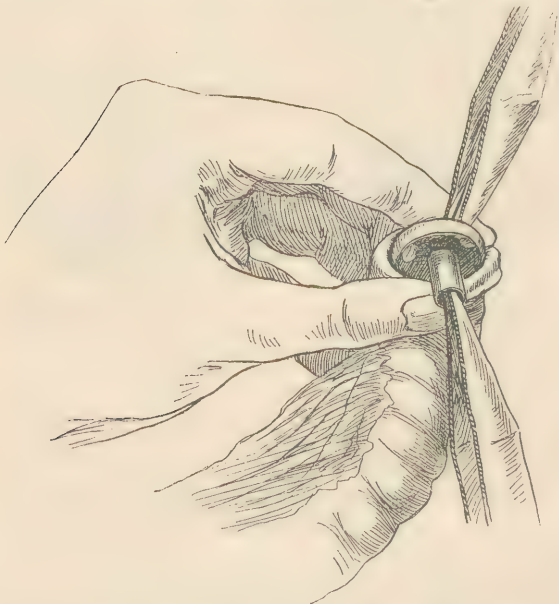


FIG. 11.—Manner of Holding Button and Bowel while Inserting Button.

55 pounds. End-to-end approximation. Button No. 2 was found to be too large to be admitted into the bowel and gall-bladder button (No 1.) was substituted. This gall-bladder button, as you see, has an opening not more than the eighth of an inch in diameter. I felt very apprehensive that this would be plugged by hair. Time, fifteen min-

utes. The dog was not in the least sick after the operation, and the button was passed on the sixth day. August 31st, killed dog; found a perfectly united bowel; omental flap adherent; no adhesion to abdominal wall. The union on the mucous side of the bowel was so perfect that the line could be made out only at one point (Fig. 14). No fistula, and no contraction at point of union. Dr. Fenger was present at the autopsy and declared, "The union is perfect."

Experiment 19.—August 9, 1892. Black female dog, weight 70 pounds. End-to-end approximation after excision of six inches of bowel. Omental flap. Time, nine minutes. August 22d, dog killed; found a union around the circumference, except at one point where the mesentery joins the bowel; here there was a small sinus leading down along the mesentery. The button was still in position. Up to this

time in the end-to-end approximation, and in this operation as well, no particular care was taken to see that the peritoneum of the mesentery overlapped, so as to prevent a portion of the muscular and mucous membrane being compressed between the edges of the button without having peritoneum covering them to form adhesion. This accounts for the sinus which existed in this case.

Experiment 23.—September 7, 1892. Black curly dog, weight 40 pounds. End-to-end approximation of ileum. Small button (No. 1). Omental flap. Time



FIG. 12.—Same as Fig. 10, closed.

eleven minutes. September 29th, dog killed ; perfect union of bowel ; omentum not adherent ; opening in bowel small, but of same size as button used, button had passed.

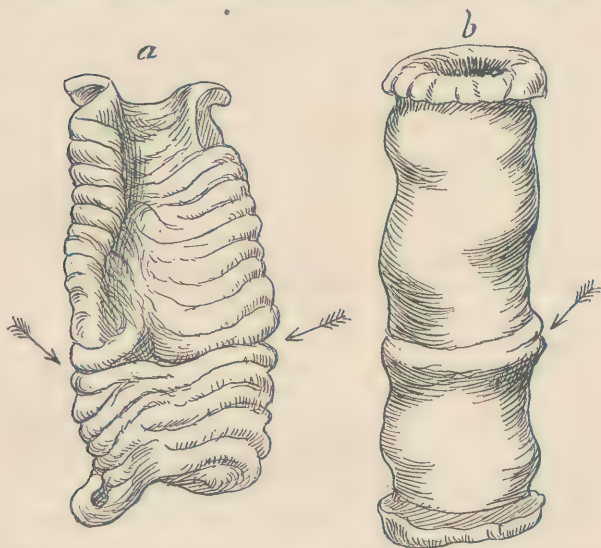


FIG. 13.—Appearance after Union when Partial Atrophy of Tissue within Clasp of Button has Taken Place.

Experiment 26.—September 8, 1892. Bull-dog, weight 55 pounds. Operated on by Dr. F. S. Hartmann in my laboratory. Excision of six inches of ileum with end-to-end approximation. Button No. 1. No omental flap. Care was taken in inserting the running thread to overlap the peritoneum at the mesentery. Time, four-

teen minutes. October 2d, opened dog's abdomen; found perfect union; button had passed; bowel somewhat smaller at point of union. The specimen was excised with six inches of the bowel, and another end-to-end approximation made on same dog.

Experiment 33.—October 2, 1892. Same dog as in Experiment 26. End-to-end approximation of ileum, after excising specimen from Experiment 26, along with six inches of bowel. Operated on by Dr. Hartmann. The button was inserted in the usual way. No omental



FIGS. 14 and 15.—Appearance of Mucous and Serous Surfaces of Bowel after Union.

flap. No scarification. Time, sixteen minutes. October 10th, the dog was playful, and ate as usual. October 12th, button was passed. There was no spring in this button. October 15th, dog killed; found perfect union; no sinus.

Experiment 28.—August 9, 1892. End-to-end approximation of ileum, performed in my laboratory by Dr. H. R. Wittwer. Same dog as in Experiment 21. Time fourteen minutes. Omental flap. September 16th, dog killed; found perfect union of bowel. The circumference of the bowel showed only partial atrophy of portion in clasp of button.

Experiment 29.—September 25th, Appleton, Wis. End-to-end approximation of jejunum, button (No. 2). Time, seven minutes. Dog killed seven days after the operation, and specimen examined by my preceptor, Dr. J. R. Reilly, of Appleton. He reported a perfect union of bowel; the atrophy was not completed. The button still in position.

Lateral Approximation or Intestinal Anastomosis.—By lateral approximation or intestinal anastomosis we understand the formation of a fistulous opening between two coils of intestine. It is performed where it is desirable to have the intestinal contents prevented from passing through a more or less constricted portion of the bowel, and where the bowel is not sufficiently constricted to cause gangrene, and it is not necessary to extirpate the constricted portion. The suggestion for such a communication originated with Maisonneuve. He was also the first to operate; both of his cases terminated fatally. The operation was almost completely forgotten until 1868, when Hacken made some experiments on dogs, and recently E. Hahn, of Berlin, brought the subject again before the profession, and still later great stress was put on the operation by Dr. Senn. The great fear of the operation was the accumulation of fæces in the excluded portion of the intestine. This fear has been found to be visionary, as the experiments recently made on animals show that if the bowel is united so that its contents continue in a direct line, that is, without making a sharp curve, there would be no fear of retention or accumulation, providing the anastomotic opening is sufficiently large. The operation was first performed with sutures.

Dr. M. E. Connell, Superintendent of the Milwaukee Hospital, suggested the use of perforated plates (see Senn's "Experimental Surgery"), which were subsequently used by Dr. Senn in his excellent experiments. The first plates used were made of wood, gutta-percha, leather, and lead. Subsequently the disks were made of absorbable material, as decalcified bone. Now we have many modifications of the method, using, in place of the bone-plates, segmented wood, coil of heavy catgut, pigmented rubber, raw potato, and turnip, etc. It was hoped from the results of the early experiments that the operation upon man of lateral approximation would be fraught with much less danger than the end-to-end. But the degree of contraction following lateral anastomosis, and the invagination of the distal end of the bowel into its lumen have increased the danger until it is equal to that of the end-to-end approximation. I have used the buttons for the lateral as well as the end-to-side approximation. The following are the experiments :

Experiment 5.—June 24, 1892. Lateral anastomosis of the jejunum with button. Operation very easily executed. Time, seven minutes. Dog had no unpleasant symptoms. Dog killed July 26th; found a perfect lateral union; opening as large as button. No accumulation of fæces in loop, but considerable atrophy. Button had passed.

Experiment 8.—June 14, 1892. Coach, female, weight 80 pounds. Lateral anastomosis of ileum; very easily performed; no escape of gas or fluids; perfect approximation. Time, sixteen minutes. The dog showed no unpleasant symptoms. July 1st, killed dog with chloroform. Found perfect union of bowel; moderately large opening; loop very much contracted; no accumulation of fæces in loop; no adhesion to abdominal wall.

Experiment 9.—June 24, 1892. Black dog, weight 55 pounds, same as used in Experiment 5. Excision of two inches of jejunum. Both ends of bowel sewed with silk-worm-gut sutures. Lateral approximation performed.

With this experiment the direction of the bowel was purposely reversed, to see what effect it would have on the adhesion. The contents of the canal, after passing through the fistulous opening, had to move in a direction opposite to its previous course before passing through the fistula. Time for suturing ends of bowels, fourteen minutes; lateral approximation with button, eleven minutes.

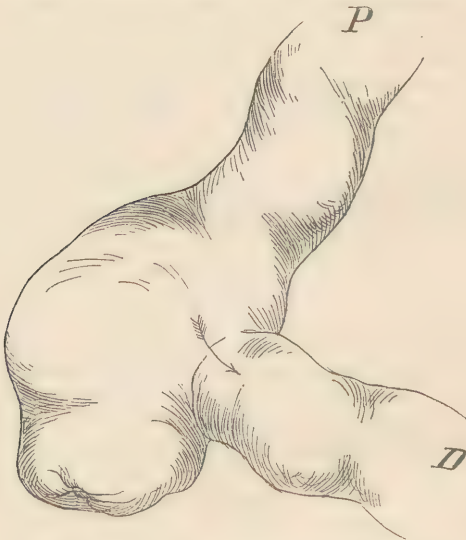


FIG. 16.—Distal End Joined to Proximal Side of Bowel after Excision (wrong way).

Total time of operation, twenty-five minutes. No omental flap. Scarification of the serous surface before approximation. The dog did not appear sick after the operation. August 23d, dog killed. Found perfect union at point of approximation. This is the most trying test that a mechanical device for producing adhesions can be subjected to. Found small invagination

of upper portion of distal end ; lower end of proximal portion of bowel very much dilated, as was anticipated ; mucous membrane inflamed and one spot ulcerated. Considerable hair had accumulated in pouch. This is in accordance with the experiments performed by the other investigators where the current of the intestinal canal was made to reverse its direction at any point.

Experiment 25.—September 8, 1892. Resection of six inches of jejunum. Approximation of the end of distal portion to the side of proximal portion of the bowel (wrong way). This is also a very severe test on the adhesion. Approximation to side one and one half inch from end. End of proximal portion sutured with silkworm-gut. Time, eighteen minutes. September 22d, dog died, as predicted. Proximal portion of the bowel very much distended (Fig. 16) ; large accumulation of hair and fæces, as anticipated ; button still in position ; bowel perfectly adherent at point of apposition.



FIG. 17.—Proximal End Joined to Distal Side after Excision of Portion of Bowel (right way).

Experiment 27.—September 9, 1892. Black and white dog, weight 45 pounds. Approximation of the proximal end to side of distal portion of bowel, right way, after resection of six inches of jejunum (Fig. 17). Here it was necessary to determine which was proximal and which was distal end. This is done as follows : A loop of

bowel is held between the fingers and parallel to the axis of the body ; the finger is slipped along down the side of the mesentery ; if it goes to the same side as started the portion toward the head is proximal, if it goes to the opposite side the portion toward the head is distal. End of bowel sewed with silkworm-gut suture. Time, nineteen minutes. Dog killed October 2d. Large piece of bone found in opening of button, completely closing it. Pressure atrophy of one-half of the circumference of the bowel that was clasped within the button had taken place, so that the fluid passed on in the alimentary canal on the side of the button in place of through the centre. There was a perfect union of bowel at point of approximation, as you will see in specimen. The line of union on the mucous side could scarcely be discerned. This specimen shows more perfectly than any other the various stages of the process of pressure atrophy.

Excision of Cæcum with Ileo-Colostomy.—This operation may be necessary, and should be successful in certain cases of carcinoma of the cæcum. The removal of this portion of the intestine has so far been followed by unfavorable results, but our advanced knowledge of intestinal surgery should make it a comparatively favorable operation. The best incision for this operation on the human subject should be from the middle of Poupart's ligament down over the tumor through the linea semilunaris. Length of incision must be governed by the size of the tumor. The cæcum is drawn out through the opening, its mesentery ligated, the required portion excised, the end sutured, the ileum cut off, and the end of the ileum approximated to the side of the colon. Experiment—end of small to end of large intestine.

Experiment 15.—July 27, 1892. Brown female dog, same as used in Experiments 7 and 12. Excision of cæcum ; running thread put around the entire circumference of the colon, and the edge drawn within the clasp of button No. 3. A similar thread put in the end of ileum and tied ; button pressed together. This approxi-

mated the end of the small to the end of the large intestine. Time, thirty-one minutes. July 28th, dog not in very good condition, refusing to eat or drink. July 30th, dog still sick and declining to eat. From that time on did very well. August 9th, killed dog. Found a perfect union of the end of the small to the end of the large intestine; button had passed; omental flap adherent; opening of same calibre as that of small intestine (Fig. 18). See specimen.

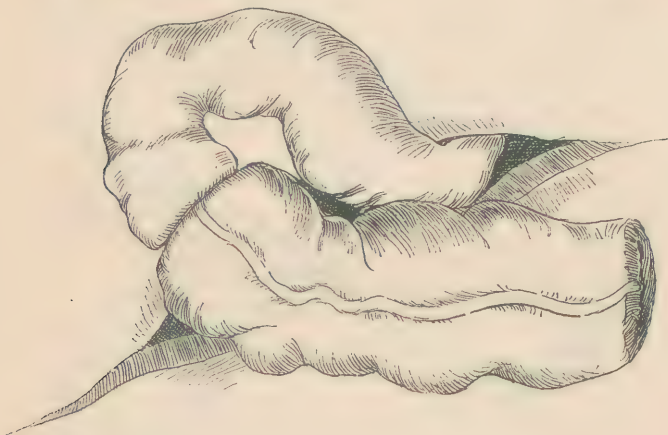


FIG. 18.—Result after Joining End of Small to End of Large Intestine (Excision of Cæcum).

Experiment 31.—August 14, 1892. Black, curly, female dog, weight 125 pounds. Ileo-colostomy. Ileum cut off at ileo-cæcal valve; opening in cæcum sewed with continuous silkworm-gut, Lembert suture. Half of button pressed in end of ileum and the other half inserted in an opening made in colon, three inches below the ileo-cæcal valve, and button joined. Omental flap. Time, sixteen minutes. In closing the abdomen the large omentum was included in the peritoneal suture. Sep-

tember 20th, dog had a miscarriage. September 29th, dog died. Autopsy showed the cause of death to be a volvulus around the omentum where it was adherent to the cicatrix in the abdominal wall. Perfect union between ileum and colon (Fig. 19); button in position; atrophy over half of its circumference; no obstruction at the seat of button; no peritonitis. This is a very



FIG. 19.—Ileo-colostomy after Excision of Cæcum (end to side).

instructive case, as it shows one of the complications that may arise from including the omentum with the peritoneal suture of the abdominal wall, so frequently advised and practised by many operators at the present time.

Besides the above cases three dogs were lost with the anæsthetic. One dog was sick when brought from the

pound ; he was operated on the following morning, and died twelve hours after, never being able to stand from the time he was taken from the table. The operation lasted only eighteen minutes, and had nothing to do with the cause of his death. In every experiment we obtained union at the seat of approximation. *This is one of the most important points brought out by the button, for it shows that a line of surface contact is just as good as half an inch for forming an adhesion*, and it practically insures against contraction where, with a larger approximation surface, contraction would certainly follow. I desire to express my thanks for, and appreciation of, the valuable services rendered me in my experiments and operations by Drs. E. W. Lee, F. S. Hartmann, and H. R. Wittwer, and by Dr. J. H. Hoelscher in placing material at my disposal ; my obligations to Dr. Wiener for using my method at an early date and to Dr. E. A. Matthæi for the drawings.

VENETIAN BUILDING, CHICAGO, December 9, 1892.

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